Federal Aviation Administration

Memorandum

Date:	September 20, 2010
To:	Manager, Transport Standards Staff, International Branch, ANM-116
From:	Manager, Transport Standards Staff, Propulsion/Mechanical Systems Branch, ANM-112
Prepared by:	Douglas Bryant, Aerospace Engineer, ANM-112
Subject:	INFORMATION: Equivalent Level of Safety (ELOS) Finding for Airbus Model A340-500 & 600, FAA Project # CP50
ELOS Memo#:	CP50-T-P-612
Regulatory Ref:	§ 25.1305 and 25.1501(b)

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate on the establishment of an equivalent level of safety finding for the Airbus Model A340-500 and -600.

Background

Title 14 Code of Federal Regulations 25.1305 requires flight deck instruments for the presentation of oil quantity, oil pressure, oil temperature , rotor speed, and a gas path temperature, among other parameters for Auxiliary Power Unit (APU) installations to insure safe operation of the APU within its limitations as required by § 25.1501(b). The flight crew workload impact of continuous monitoring of these parameters is inconsistent with a two-person flight crew.

Modern APU installations use an electronic control unit designed to maintain certain APU operating parameters within normal operating ranges when operated within approved flight and ground operating envelopes. In the event that a monitored parameter reaches its operating limit, or a fault develops, an automatic APU shutdown is initiated. It is therefore possible that the need for some of the instrumentation required by § 25.1305 may be obviated if the automatic features of the APU and its installation duplicated the actions that would be taken by a flight crew in the event of an APU system fault or limit exceedence.

Applicable regulation(s)
§§ 25.1305 & 25.1501(b)

Regulation(s) requiring an ELOS
§§ 25.1305 & 25.1501(b)

Description of compensating design features or alternative standards that allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The functioning of the APU installed on the airplane is fully controlled by the Electronic Control Box (ECB), which is a full authority digital electronic controller. The ECB performs the APU system logic for all modes of APU operation such as:

- Sequence the start and monitors it,
- Monitors speed and temperature,
- Monitors bleed air,
- Sequences the shut down (manual or automatic),
- Controls the automatic shutdown.

The APU may run without cockpit crew supervision, when the aircraft is on ground.

The following failures cause an automatic shutdown:

- In flight and on the ground:
  - Over-speed , ECB failure, APU generator high oil temperature, clogged oil filters,
- On the ground only (inhibited in certain phases of flight):
  - Under-speed, Low oil pressure, Intake flap not open, Main power interrupt, Sensor failure, APU high oil temperature, Inlet overheat, Over-temperature, Reverse Flow, No flame, No acceleration, No speed.

When a parameter monitored by the ECB reaches its operational limit, the APU is automatically shutdown. In that case, the APU master switch fault light illuminates amber and a caution message is displayed. In addition, the master caution light illuminates, a single chime aural warning sounds, and the APU system page is automatically called on the system display.

In the case that the automatic shutdown is inhibited, the APU master switch fault light illuminates amber, a caution message is displayed, and the APU system page is automatically called on the system display.

The APU system page can be called on the system display at any time and includes the following indications:

- APU availability
- APU bleed valve position
- APU bleed air pressure
- APU GEN line contactor and generator parameters
- APU Fuel low pressure
- APU air intake flap position
- APU low oil level
- APU rotor speed with red line limit
- APU exhaust gas temperature with red line limit
- APU fuel used indication

In addition to the automation shutdown function, the APU system page is automatically called in the following cases:

- Advisory (Flashing green):
  - Low oil level,
- Caution (Amber):
  - Fuel low press,
- Warning (Red):
  - Over-speed,
  - Over-temperature.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

Although noncompliant with the regulation, the use of the automatic shutdown with continuous monitoring of APU parameters by the ECB and automatic display to the flight crew when exceeded in a two-person crew airplane are considered to provide adequate compensation for the lack of the required indication. Relevant compensating features include: (1) automatic shutdown of the APU when an operating limit is exceeded, (2) automatic display of APU system page when an automatic shutdown occurs or operating limit is exceeded, and (3) the master caution light illuminates, a single chime aural warning sounds, the APU master switch fault light illuminates amber, and a caution message is displayed to the flight crew when an automatic shutdown occurs. In addition, despite the absence of continuous indication of APU operating parameters, it is considered that the installation of automatic system may improve the level of safety required by direct compliance to § 25.1305.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned equivalent level of safety finding in project issue paper P-612, titled "Auxiliary Power Unit (APU) Installation and Monitoring Requirements." This memorandum provides standardized

documentation of the ELOS finding that is non-proprietary and can be made available to the public. The Transport Airplane Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum number should be listed in the Type Certificate Data Sheet under the Certification Basis section. (TCs & ATCs) or in the Limitations and Conditions Section of the STC Certificate in accordance with the statement below:

Equivalent Level of Safety Findings have been made for the following regulation(s):
14 CFR 25.1305, Powerplant instruments, and 25.1501(b), Operating Limitations and Information
(documented in TAD ELOS Memo CP50-T-P-612).

September 20, 2010

Manager, Propulsion/Mechanical Systems Branch, ANM-112
Transport Standards Staff

Date

ELOS Originated by: Standards Staff, Propulsion Branch	Project Engineer: Douglas Bryant	Routing Symbol: ANM-112